DOCUMENT RESUME

ED 380 287 SE 055 917

TITLE	NSF in a Changing World: The National Science Foundation's Strategic Plan.
INSTITUTION	National Science Foundation, Washington, D.C.
REPORT NO	NSF-95-24
PUB DATE	95
NOTE	44p.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Educational Objectives; Educational Planning; *Engineering Education; Government Role; Long Range Planning; *Science Education; *Scientific Research; *Strategic Planning
IDENTIFIERS	*National Science Foundation

ABSTRACT

The National Science Foundation's (NSF) role as a leader and steward of the Nation's science and engineering enterprise faces new tests--promoting new approaches to research, education, and workforce training that reach all Americans; responding to the increased importance of science and engineering in many aspects of daily life; modernizing the Nation's research infrastructure, and adapting to a constrained budget environment. The purpose of the plan, developed by the NSF Task Force on Strategic Planning and Policy to deal with these new challenges, is to delineate NSF's unique contributions to science and engineering research and education, and to the federal research portfolio. The plan provides a context for shaping NSF's future by noting how recent domestic and global changes have affected national research and education priorities, and contains a set of core strategies that NSF will employ. These strategies include: develop intellectual capital, strengthen the physical infrastructure, integrate research and education, and promote partnerships. Section titles include: (1) "Leadership in a Time of Change and Opportunity"; (2) "The NSF Vision"; (3) "The NSF Mission"; (4) NSF's Goals...Setting a True Course"; (5) "Meeting Our Goals" (describes the core strategies); (6) "Enabling World Leadership"; (7) "In Service to Society: NSF Strategic Areas"; (8) "Excellence in Education at All Levels" (examines four categories: systemic reform K-12, the workforce, flexibility in advanced training for scientists and engineers, and scientific and technological literacy); (9) "Approaches to Implementation"; and (10) "Planning and Allocation of Resources." (LZ)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

NSF IN A CHANGING WORLD

The National Science Foundation's Strategic Plan

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED 380 287

SE055917

BEST COPY AVAILABLE

NSF IN A CHANGING WORLD

The National Science Foundation's Strategic Plan

3

A Publication of the National Science Foundation • 1995

NSB-94-183

RESOLUTION APPROVED BY THE NATIONAL SCIENCE BOARD AT ITS 324TH MEETING, ON OCTOBER 14, 1994

National Science Foundation's Strategic Plan

WHEREAS, Presidential and Congressional directives call for the National Science Foundation to prepare a strategic plan that incorporates a vision of the Foundation's future and the goals and strategies designed to realize that vision;

WHEREAS, with the guidance of the National Science Board, the Foundation's Director and staff have developed such a plan;

WHEREAS, the vision, goals and strategies set forth in the plan would better enable the Foundation to exercise its leadership and stewardship for scientific and engineering research and education, thus accomplishing Presidential and Congressional goals for investment of public funds;

Now therefore be it

RESOLVED, that the National Science Board approves the proposed plan entitled "NSF in a Changing World," as agreed upon by the NSF Task Force on Strategic Planning and Policy at its meeting of October 13, 1994

AND requests the Director to make such editorial changes as may be necessary, to publicize the plan widely, and to distribute it to all parts of the Nation's research and education community.

Contents

Executive Summary	2
Leadership in a Time of Change and Opportunity	5
The NSF Vision	9
The NSF Mission	11
NSF's Goals...Setting a True Course	13
Meeting Our Goals	17
Enabling World Leadership	21
In Service to Society: NSF Strategic Areas	25
Excellence in Education at All Levels	29
Approaches to Implementation	33
Planning and Allocation of Resources	37
Acknowledgments	38

Executive Summary

Since its inception in 1950, the National Science Foundation has served the Nation by investing in research and education in all aspects of science, mathematics, and engineering. As the recent report, *Science in the National Interest**, stressed, "America's future demands investment in our people, institutions, and ideas. Science is an essential part of this investment, an endless and sustainable resource with extraordinary dividends."

Over the years NSF's investments in research and education have helped the Nation achieve an unmatched capability in scientific and technical fields — a capability that has taken on increasing importance as we approach the 21st century.

Today, NSF's role as a leader and steward of the Nation's science and engineering enterprise faces new tests — promoting new approaches to research, education, and workforce training that reach all Americans; responding to the increased importance of science and engineering in many aspects of daily life; modernizing the Nation's research infrastructure, and adapting to a constrained budget environment.

This plan underscores the advantages that result from advances in understanding, and it emphasizes the principles that have guided the Foundation from its beginning — excellence, openness, stewardship, and impact on society. It provides a framework for moving forward in a changing environment that is grounded in the enduring values that guide NSF's mission, and it encourages flexibility in the methods used to promote the progress of science and its benefits to society.

The NSF mission, as established by Congress, is to promote the progress of science and engineering. In today's environment, fulfilling this mission requires that NSF continue to advance the discovery of new knowledge and exercise greater leadership in mathematics, science, and engineering education while taking steps to promote the dissemination, integration, and application of new knowledge.

The purpose of this plan is to delineate NSF's unique contributions to science and engineering research and education and to the Federal research portfolio. The plan provides a context for shaping NSF's future by noting how recent domestic and global changes have affected our national research and education priorities. Within this context, the plan sets forth NSF's mission, its vision, and the following long-range goals:

Enable the U.S. to uphold a position of world leadership in all aspects of science, mathematics and engineering. This goal grows from the conviction that a position of world leadership in science, mathematics, and engineering provides the Nation with the broadest range of options in determining the course of our economic future and our national security.

* *Science in the National Interest*, Executive Office of the President, Office of Science and Technology Policy, August 1994.

Promote the discovery, integration dissemination, and employment of new knowledge in service to society. This goal emphasizes the connection between world leadership in science and engineering on the one hand, and contributions in the national interest on the other. It provides the impetus for setting fundamental research priorities in areas that reflect national concerns.

Achieve excellence in U.S. science, mathematics, engineering, and technology education at all levels. This goal is worthy in its own right, and also recognizes that the first two goals can be met only by providing educational excellence. It requires attention to needs at every level of schooling and access to science, mathematics, engineering, and technology educational opportunities for every member of society.

To move toward the achievement of these goals, the strategic plan contains a set of core strategies that NSF will employ. These strategies reaffirm the Foundation's traditions, especially its reliance on merit review of investigator-initiated proposals, yet at the same time point to new directions for the Foundation:

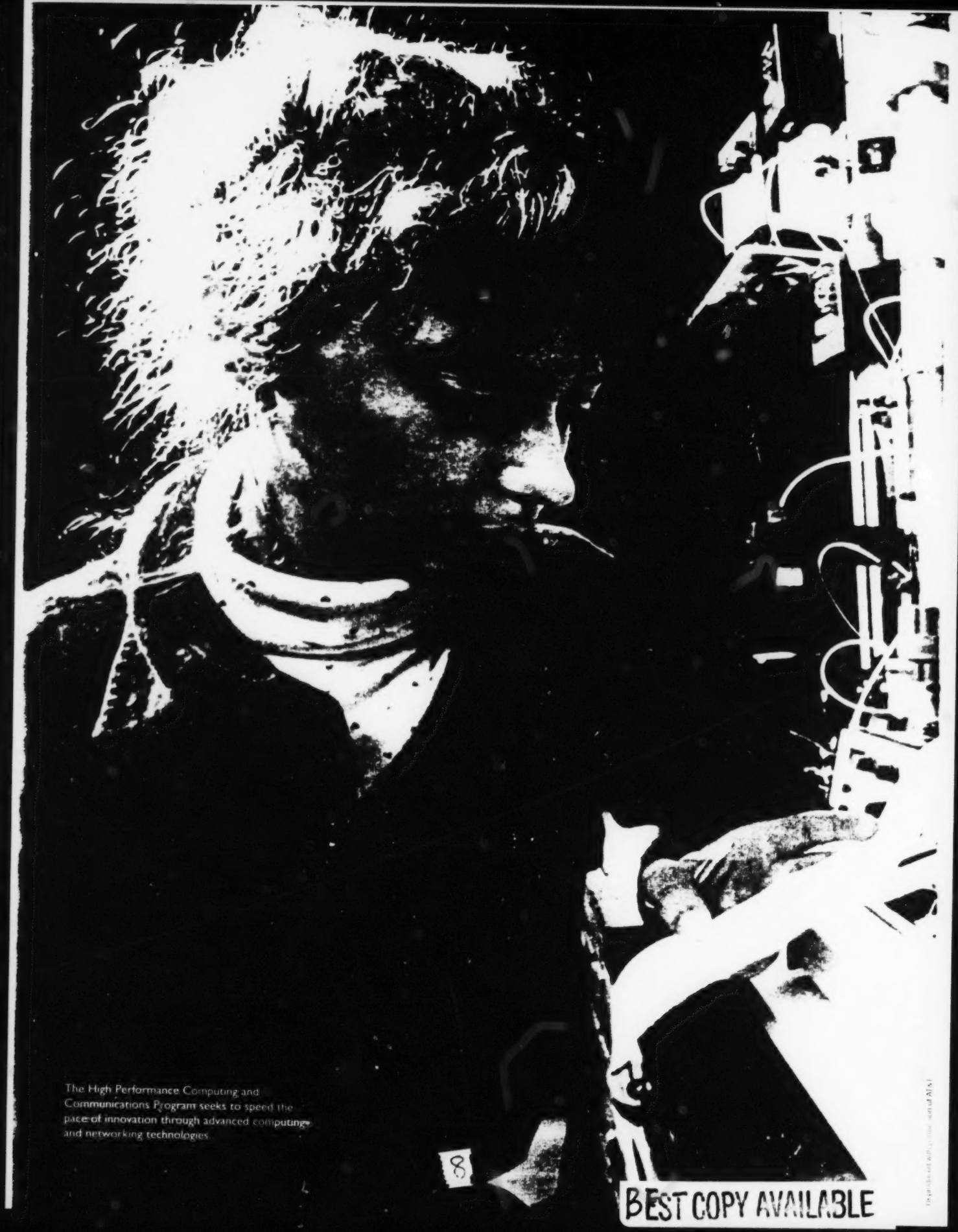
Develop intellectual capital: Seek out and support excellent activities among groups and regions that traditionally have not participated as full stakeholders in science, mathematics, and engineering, including women, minorities, and individuals with disabilities.

Strengthen the physical infrastructure: Modernize existing facilities and instruments and plan for future needs, including taking full advantage of the capabilities of emerging information technologies.

Integrate research and education: Infuse education with the joy of discovery and an awareness of its connections to exploration through directed inquiry, careful observation, and analytic thinking for students at all levels.

Promote partnerships: Continue to collaborate with the academic community, industry, elementary and secondary schools, other Federal agencies, state and local governments, and comparable organizations worldwide. NSF's approach to partnerships emphasizes shared investments, shared risks, and shared benefits.

This strategic plan is an invitation to the research and education communities to respond to a rapidly changing world. It emphasizes a set of principles, goals, and core strategies for science, mathematics, and engineering that are aimed at developing a greater sense of interdependence between the research and education communities and the public. Only by succeeding in this partnership can we realistically expand the promise of science and more fully engage the public in its future course.


The High Performance Computing and Communications Program seeks to speed the pace of innovation through advanced computing and networking technologies.
8
BEST COPY AVAILABLE

Leadership in a Time of Change and Opportunity

Throughout its history, the National Science Foundation has fostered and strengthened America's capacity to excel in science, mathematics, and engineering. NSF has done this by promoting the pursuit of excellence in research and education in all fields of science and engineering, and by providing leadership and stewardship for institutions engaged in learning and discovery.

Today, the importance of NSF as a critical investment in the Nation's future is increasingly evident. As America looks beyond a world view shaped by the Cold War, countless other challenges move to the forefront — securing long-term economic growth, protecting the quality of the environment, raising the scientific and technical skills of the workforce, building an information infrastructure, rebuilding the physical infrastructure, and generally improving the quality of life for all people. All of these challenges test the Nation's science and engineering capabilities, and meeting them requires sustained investments in fundamental research and education. The recent report on science policy issued by President Clinton and Vice President Gore — *Science In the National Interest* — underscores this very point. The report opens by saying, "America's future demands investment in our people, institutions, and ideas. Science is an essential part of this investment, an endless and sustainable resource with extraordinary dividends."

In providing leadership for research and education activities, NSF takes advantage of its unique position in the government's portfolio of R&D programs. NSF's budget accounts for only four percent of Federal research and development spending. Its investments must be catalytic, if they are to be influential. NSF focuses on academic institutions, supporting over twenty-five percent of the basic research they conduct. This focus has led to a long-standing, synergistic partnership between NSF and the academic enterprise, one that provides the Nation with a continuous supply of both new knowledge and future generations of scientists, engineers, educators, and other technically-trained professionals. The partners share both the opportunities and responsibilities of recogniz-

Today's challenges test the Nation's science and engineering capabilities, and meeting them requires sustained investments in fundamental research and education.

ing and responding to the challenges of the present and the future, be they readying the industrial base for competition in the global marketplace, updating school math and science curricula to meet the needs of all students, or observing and studying a rare, awe-inspiring event like this summer's collision between Comet Shoemaker/Levy 9 and the planet Jupiter.

Fostering Linkages

Because NSF is charged with promoting the progress of science and engineering generally (rather than focusing on a specific mission in one area of science and technology), the agency's programs reach all disciplines and all levels of education and human resource development. This breadth of coverage gives the agency both the ability and the responsibility to foster the different types of linkages, synergies, and connections that are essential to effective investments for the Nation in science, mathematics and engineering. Supporting interdisciplinary research, fostering partnership with other agencies and institutions, integrating research and education, providing leadership in strategic areas of research and education, promoting international cooperation, and promulgating the highest standards of quality and excellence in all aspects of research and education are critical to the agency's future success. Its ability to contribute to the Nation depends on the leadership it provides for these types of activities.

NSF's role ... has recently taken on a number of important new dimensions that severely test the agency's capacity for leadership and stewardship in a time of change.

New Dimensions of Leadership

Today, America holds the preeminent position in what is truly a global science and engineering enterprise. Our research universities are a magnet for students and scholars from all nations, and other nations are beginning to adopt NSF's approaches to support for investigator-initiated, merit-reviewed research and education. Yet neither the Nation nor the Foundation can rest on past achievements. Indeed, NSF's role as a leader and a steward of the research and education enterprise has recently taken on a number of important new dimensions that severely test the agency's capacity for leadership and stewardship in a time of change.

First and foremost, even though science and technology remain priority areas for Federal investments, the overwhelming need to reduce the Federal budget deficit makes clear that NSF must set rigorous priorities based on realistic budgetary expectations, develop effective mechanisms for evaluation and assessment, and promote partnerships with other agencies and institutions. NSF must develop the mechanisms to determine where activities must be started, sustained, or phased down and the strength to act on these determinations.

Second, NSF's longest-standing partners — the Nation's colleges and universities — are facing an era of reduced growth in resources and major changes in the demographics of their enrollments. These shifts and their impact on the continued health and vitality of the academic enterprise will lead to modifications in the character of its partnership with NSF. This evolution deserves careful consideration in NSF's planning.

Third, the emerging challenges and opportunities of an evolving American workforce require that NSF devote increased attention to addressing the scientific and technological skills necessary for the workplace and to ensuring that all members of our society have a real opportunity to succeed in attaining them.

Fourth and finally, numerous other changes — such as restructurings of industrial research, efforts by states

to understand and coordinate their science and technology bases, the increasingly global nature of research, new appreciation for the interdependence of basic research and its potential uses, and the growing importance of science and technology in daily life — impel the Foundation to reexamine how it structures its programs, develops priorities, and communicates the importance of the activities it supports.

The purpose of this strategic plan is to strengthen NSF's position to address and respond to these and other changes and challenges that are reshaping society's rationale for investments in science, mathematics, and engineering. In its development, NSF has drawn upon the same wealth of ideas emerging from the science and engineering community that shaped *Science in the National Interest*. The plan contains many of the same themes and describes the Foundation's view of its role in fulfilling the Administration's objectives for investments in research and education.

Reaffirming Core Values

In strengthening NSF's position, the plan reaffirms certain core values and commitments that form the cornerstone of the agency's tradition of success. NSF remains committed to supporting and promoting:

- The most creative ideas and capable researchers, selected through merit review, including peer evaluation, of investigator-initiated proposals;
- Pathbreaking research at many points on the frontiers of science, mathematics, and engineering;
- Excellence in education and in the development of human resources in science, mathematics, and engineering — building upon the natural linkages between education and research;
- The effective discovery, dissemination, integration, and application of new knowledge through cooperation with industry, other Federal agencies, states, and public and private organizations concerned with science and technology; and
- A partnership of trust built with America's scientists, mathematicians, and engineers that serves the best interests of the American people.

Reprinted with permission of AT&T

Advanced materials research provides new insight into the structure of matter.

These core values and commitments establish a strong foundation for NSF — one that is rooted in the agency's tradition of success yet also provides the underpinnings for its future leadership.

In summary, this plan provides a starting point and directional guide for choosing among the many possible future paths that lie before NSF. It begins with three essential points of reference for the Foundation: a bold vision for the agency's future, a contemporary interpretation of its statutory mission, and a new formulation of its goals.

The NSF Vision

As for the future,
your task is not to foresee it,
but to enable it.

— Antoine de Saint-Exupery

The National Science Foundation is a catalyst for progress through investment in science, mathematics, and engineering. Guided by its longstanding commitment to the highest standards of excellence in the support of discovery and learning, NSF pledges to provide the stewardship necessary to sustain and strengthen the Nation's science, mathematics, and engineering capabilities and to promote the use of those capabilities in service to society.

NSF is confident in the power of its connections and partnerships to deliver the greatest return on this investment. It will exercise leadership in strengthening linkages among the many individuals, institutions, and organizations that are committed to progress in research and education. It will also dedicate itself to fostering the natural connections between the processes of learning and discovery.

T.W. Fleming

Surveying changes in numbers and distribution of species enables researchers to monitor changes in Earth's biodiversity.

At the core of this vision is a dynamic and diverse community of researchers, educators, and institutions who work in partnership with NSF. This community shares with NSF a commitment to discovery and learning, to enhancing the Nation's capacity for excellence in research and education, and to the use of science, mathematics, and engineering for the betterment of humanity.

By introducing a signal gene from E.coli bacteria
into this seedling, scientists and engineers
supported through NSF's Biotechnology Initiative
discover how environmental signals activate genes

BEST COPY AVAILABLE

The NSF Mission

The National Science Foundation Act of 1950 (Public Law 81-507) set forth NSF's mission and purpose:

To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense....

The Act authorized and directed NSF to initiate and support:

- basic scientific research and research fundamental to the engineering process,
- programs to strengthen scientific and engineering research potential,
- science and engineering education programs at all levels and in all the various fields of science and engineering,
- programs that provide a source of information for policy formulation,
- and other activities to promote these ends.

Over the years, NSF's statutory authority has been modified in a number of significant ways. In 1968, authority to support applied research was added to the Organic Act. In 1980, The Science and Engineering Equal Opportunities Act gave NSF standing authority to support activities to improve the participation of women and minorities in science and engineering. Another major change occurred in 1986, when engineering was accorded equal status with science in the Organic Act.

NSF has always dedicated itself to providing the leadership and vision needed to keep the words and ideas embedded in its mission statement fresh and up-to-date. Even in today's rapidly changing environment, NSF's core purpose resonates clearly in everything it does: promoting achievement and progress in science and engineering and enhancing the potential for research and education to contribute to the Nation. While NSF's vision of the future and the mechanisms it uses to carry out its charges have evolved significantly over the last four decades, its ultimate mission remains the same.

The radio telescopes and other astronomical facilities that NSF supports enable researchers to view the universe from multiple perspectives.

BEST COPY AVAILABLE

NSF's Goals...Setting a True Course

This strategic plan establishes three broad, closely interrelated goals for NSF that show the way to realizing the agency's vision and fulfilling its statutory mission. These goals both reflect and reach beyond NSF's traditions — with the intent of placing the Foundation in a pivotal position to help secure the Nation's scientific and technological future:

Enable the United States to uphold a position of world leadership in all aspects of science, mathematics, and engineering.

Promote the discovery, integration, dissemination, and employment of new knowledge in service to society.

Achieve excellence in U.S. science, mathematics, engineering, and technology education at all levels.

The first goal listed above is truly an overarching goal for the Foundation. It is a direct extension of the Administration's goal of "World Leadership in Basic Science, Mathematics, and Engineering." World leadership in all aspects of science, mathematics and engineering requires that the second and third goals be attained. Those latter goals are components of the first that are particularly timely. Likewise, world class efforts across a broad spectrum of science, mathematics and engineering support the attainment of the second and third goals. Their achievement depends on an ample infrastructure of talent, ideas, and physical and financial resources.

Upholding World Leadership

NSF sees its role as enabling the U.S. to uphold a position of world leadership in research and education. It will work to fulfill this goal by providing the U.S. with a world-leading capability in all aspects of science and engineering — inquiry and discovery, dissemination, integration, and application of knowledge, education and training, facilities and instrumentation. This entails taking advantage of NSF's many unique strengths — especially its commitment to excellence, its ability to work in partnership with other organizations, its commitment to linking the processes of education and research, and its experience at connecting research and

World class efforts across a broad spectrum of science, mathematics and engineering support the attainment of NSF's goals.

education to national priorities. The agency strives to ensure that the Nation retains a strong human and physical infrastructure for science, mathematics, and engineering. This infrastructure is both a key to world leadership and a resource on which the Nation may draw for other purposes. Upholding a position of world leadership requires exercising leadership to promote international cooperation in science and engineering, and NSF pledges to make international cooperation an important element of meeting this goal.

Promoting the discovery and dissemination of new knowledge is the traditional core of NSF's activities. Integration across fields of knowledge and tying discovery to the potential uses of new knowledge have played an increasingly important role in NSF's programs in recent years. The second goal signifies the importance of combining all these elements in our programmatic activities. It also describes NSF's explicit recognition of the role of science, mathematics and engineering in service of society. NSF is committed to devoting a significant and balanced portion of its portfolio to areas of strategic importance to the Nation. In cooperation with the Administration and the Congress, and with input from the private sector and other organizations, NSF will define and revise its role in such areas through its continuing planning process.

David Hoffman, James T. Hoffman

This computer-generated image of minimal surface area illustrates how advanced imaging technologies have opened new frontiers in mathematics and other disciplines.

The third goal encapsulates NSF's threefold commitment to science and engineering education and human resource development: (1) to give every American the understanding of science, mathematics, engineering, and technology needed for full participation as an educated citizen and for personal enrichment; (2) to provide the Nation with a technologically sophisticated workforce; and (3) to provide opportunities for young people that will attract them to and prepare them for careers in science, mathematics, and engineering.

Catalyzing Partnerships

NSF holds no illusions that it can achieve these goals unilaterally. That is why this plan places such strong emphasis on working in partnership with other public and private organizations engaged in science, mathematics, and engineering. As the first sentence in "The NSF Vision" (p.9) states, NSF views itself as a "catalyst" — meaning it provides the tools, the programs, and the funding to help others pursue the frontiers of knowledge and advance teaching and learning. In simplest terms, NSF lives, leads, and works through its many partners in the research and education enterprise.

Partners

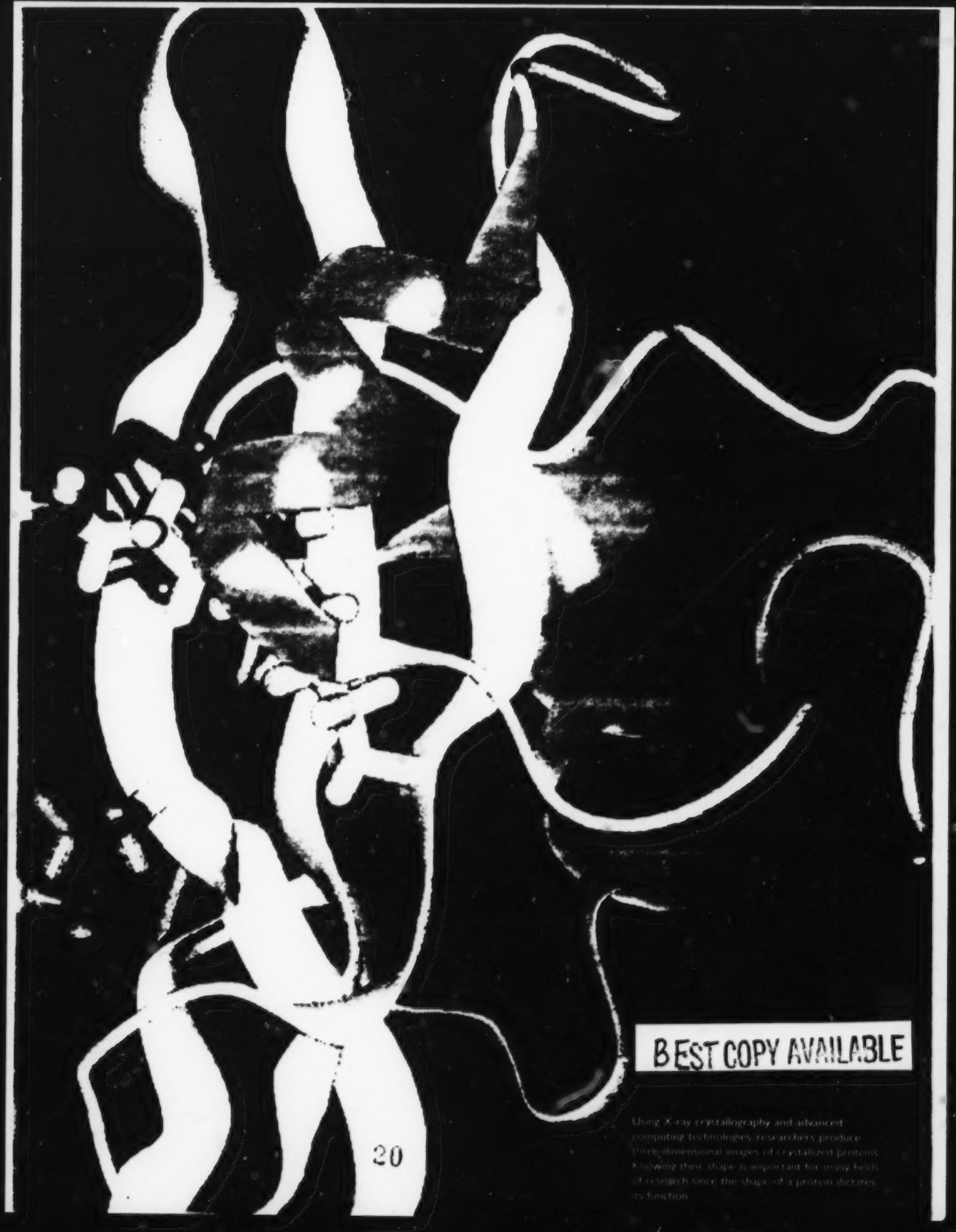
Every citizen is a partner. The Nation as a whole—and its representatives in Congress—has a direct interest in how successful the Foundation is in fulfilling its mission because NSF supports science and engineering research and education that contribute broadly to the Nation's well being.

These benefits are diverse but nevertheless very real. Public spending on fundamental research is an investment in the future—one which is indispensable to the Nation's long-term economic well being, environmental protection, public health, and national security. NSF's programs provide educational benefits that include improved teaching of science, mathematics, and engineering. These outcomes lead to a better prepared workforce, and to a better understanding and appreciation of science and engineering by the public.

In day-to-day operations the Foundation's most direct interactions are with these partners:

- Grantees, most of them at colleges and universities, benefit directly from NSF funding. These partners include individual scientists, engineers, and educators; officials who lead the universities; and students who receive financial aid and the educational benefits of campus-based research. In addition to the direct benefits, NSF-supported research and education helps to create the next generation of educators, researchers and administrators for academia.
- Private sector business and industry benefit from ideas generated by NSF-supported research and education. A well-prepared general workforce benefiting from NSF's efforts in the schools and a technically skilled workforce of scientists and engineers are critical to the success of the U.S. economy. NSF's programs contribute to the improvement of education in schools, colleges, and universities.
- Other Federal agencies rely on fundamental research produced by NSF-funded researchers and on the availability of a workforce upgraded by NSF programs. Moreover, many of these agencies' programs are carried out in formal partnership with NSF.
- State and local officials look to NSF as a stimulus for economic development through its support for research in small businesses and industry-university partnerships.
- Schools and communities benefit directly from NSF-funded improvements in curricula, instructional strategies, teacher preparation and educational technologies which lead to systemic educational reform.
- Policy makers and researchers in all these sectors rely on NSF as a source of reliable data and analysis pertaining to science and engineering.
- Communications media inform the public about new developments in science and engineering. They rely on NSF and NSF-supported researchers for news, and they are essential in building public support for science.

All of these diverse partners need to be considered and included when setting performance objectives and evaluating NSF programs.



BEST COPY AVAILABLE

Using X-ray crystallography and advanced computing technologies, researchers produce three-dimensional images of crystallized proteins. Knowing their shape is important for many fields of research since the shape of a protein dictates its function.

Meeting Our Goals

To exert the catalytic leadership necessary to meet its goals, NSF must draw on its particular strengths and responsibilities within the Federal portfolio of programs investing in research and education in science and engineering. NSF's relative strengths — a prominent role in the support of research and education at academic institutions and an obligation to attend to the progress of science and engineering in a very broad sense — must be central elements in determining the core strategies that will address NSF's three overlapping goals. At the same time, NSF's mission responsibilities — support of research and education projects and strengthening scientific and engineering research potential — must be properly balanced for effectiveness in achieving its vision and accomplishing its mission in the current environment.

Core Strategies

NSF has identified four core strategies that are designed to build a strong resource base on which its research and education programs can draw. These strategies enhance the Nation's capacity to perform as it makes progress in science and engineering:

- Develop Intellectual Capital.
- Strengthen the Physical Infrastructure.
- Integrate Research and Education.
- Promote Partnerships.

Each of these strategies is embodied in some way in NSF's programmatic portfolio. Highlighting them and developing new approaches to implementing them will make an important difference in what NSF contributes to the Federal portfolio of investments in research and education.

The first two core strategies have to do with basic components of infrastructure, the foundation on which everything else stands. For NSF to reach its goals, the Nation must have a healthy, world class infrastructure for research and education that comprises both human resources (researchers, educators, students) and physical resources (facilities, equipment, instruments) at its research and education institutions.

Develop Intellectual Capital. NSF's investments in the Nation's intellectual capital, that is, in the people and the ideas they create, are essential to meeting the agency's three goals.

Selecting the best ideas in research and education and the most capable people to carry them out is at the heart of NSF's programmatic activities and the merit review system with which we implement those programs. This approach and the philosophy underlying it are part of the core values of the organization. The

approach is only effective when the pool of ideas and talent on which the process draws is far-reaching.

NSF works to ensure that this pool is as extensive and diverse as possible by seeking out and supporting excellent activities that involve groups and regions that traditionally have not participated fully in science, mathematics, and engineering. This includes, in particular, women, minorities and individuals with disabilities. In a democratic society that is highly dependent on science, mathematics and engineering for its well-being and its place in the world, the scientific enterprise cannot thrive unless it is open to all segments of the population. Diversifying the workforce to create a more inclusive and robust scientific enterprise is necessary to assure excellence. Bringing the benefits of a diverse population to science, mathematics and engineering requires that NSF work with its partners toward the assignment and acceptance of responsibility for assuring that the full range of talents in the population is engaged.

America's future depends on the next generation, those currently being educated in our schools, colleges, and universities or embarking on their careers in industry, academia, or government. Enhancing their capacity to perform — create, innovate, and solve problems — and to demonstrate that capacity must be a vital component of NSF's activities. Vibrant educational programs for all students, resources to pursue advanced education and training, and resources to initiate research and education programs are important components of this enhancement.

In a democratic society that is highly dependent on science, mathematics and engineering, the scientific enterprise cannot thrive unless it is open to all segments of the population.

Acknowledging excellence when it is fully apparent is comparatively easy; recognizing potential, and developing the capacity for excellence is a much more difficult task. NSF is committed to making this task an integral part of upholding world leadership.

Strengthen the Physical Infrastructure. In many situations in science and engineering, creative, innovative ideas go unexplored because the physical resources necessary for their pursuit are not available.

To strengthen the physical component of the science and engineering infrastructure, NSF's programs support investments in facilities planning and modernization, instrument acquisition, instrument design and development, and shared-use research platforms. In all of these areas, NSF is promoting the development of an intelligent, agile, and adaptable infrastructure for the future — one that takes full advantage of the capabilities of the emerging information infrastructure.

The physical infrastructure is an enabling aspect of NSF's activities. It helps create an environment in which effective progress is possible. The Foundation also is working with the National Science and Technology Council to develop a mechanism for interagency coordination of infrastructure support.

Integrate Research and Education. NSF's close involvement with academic institutions gives it the ability to promote the closer coupling of research and education, an ability the Foundation is only beginning to use effectively. Support for basic research in an education-rich environment characterizes the American research endeavor and distinguishes it from that in many other countries. Effective integration of research and education means that both the findings and methods of research can be quickly and effectively communicated in a broader context and to an expanded audience. This enhances the impact of the research and strengthens the infrastructure of science and technology.

Education in a research-rich environment permits informed decisions on what can and should be taught and emphasizes for students the importance of generating new ideas and approaches, preparing them to do the same in their future careers. It also serves to produce the next generation of research-trained college and university faculty and a teaching corps that understands the real nature of science, a regeneration process that keeps the entire system vital.

Molecular models have applications in many areas – including pharmaceutics, advanced materials, and education.

Most research NSF supports takes place at academic institutions where the opportunity for educational interaction is abundant. Advanced training in science and engineering generally includes a research apprenticeship component, where students learn about research by doing it. Yet NSF recognizes that most education takes place outside of a research environment, and that there are stresses in the system that make it difficult to take advantage of the natural connections between research and education, even in our research universities.

NSF aims to engage researchers and educators in a joint effort to infuse education with the joy of discovery and to bring an awareness of the needs of the learning process to research, creating a rich environment for both. We will foster these natural connections through programmatic activity that brings out the synergy between research and education and that provides incentives for those who want to strengthen the connections. This approach emphasizes the strong bond between learning and inquiry. It recognizes the importance of building a solid understanding of math and science principles, as well as developing skills for formulating and solving substantive problems. It provides the foundation that will allow students to address effectively complex situations they have not previously encountered.

Promote Partnerships. This plan is based on the premise that NSF cannot reach its goals by itself. Success requires collaboration with many different partners, including the academic community, industry, elementary and secondary schools, other Federal agencies, state and local governments, and other institutions involved in science and engineering. Our goal of world leadership requires that we carry our partnerships across national boundaries, working with comparable organizations in other countries to promote international cooperation wherever mutually beneficial.

NSF's responsibility for activities across the spectrum of fundamental science, mathematics and engineering promotes its effective partnership in a variety of situations, particularly between the discoverers and the potential users of new knowledge. Partnerships also permit the agency to take advantage of the ties that the interdependence of basic research, applied research, and technology create among Federal agencies. Effective partnerships bring together the best minds in our society and may also help to share the fiscal responsibilities for research and education. Shared investments, shared risks, and shared benefits are key elements in NSF's approach to partnerships.

Enabling World Leadership

"This country must sustain world leadership in science, mathematics, and engineering if we are to meet the challenges of today... and tomorrow."

—President Clinton
November 23, 1993

As this statement by the President indicates, America's leadership in science, mathematics, and engineering is essential to the Nation's future success and continuing prosperity. World leadership in science and engineering is not a luxury that should be pursued only in times of rapid economic growth. America's position of world leadership creates a valuable asset that yields countless dividends for our entire society.

Science in the National Interest underscores this point and recognizes that upholding world leadership is not simply a matter of preserving the status quo: "To sustain the leadership position we now hold, we must improve the conditions, capabilities, and opportunities for well-trained scientists and engineers to pursue innovative research; to educate the next generation; and to apply science in areas of importance to the health, prosperity, and security of the country."

As the only Federal agency mandated to promote the health of science generally, NSF has a central role in upholding the Nation's position of world leadership, one of the priorities of the President's National Science and Technology Council (NSTC). This influences the agency's broad base of activities in research and education and its support for both the physical and intellectual infrastructure of science and engineering.

Themes for Investment

Throughout this and following sections, the four core strategies described above provide a basic framework for the Foundation's activities. The Foundation has identified several key themes for its investments in research and education:

Providing Balanced Support Across the Frontiers of Knowledge — Through NSF's support for a broad base of research and education activities, the Nation is able to capitalize on new advances and new opportunities

wherever they may occur as well as anticipate and deal with new and unexpected challenges in a timely way. NSF constantly examines the status of science and engineering, using workshops, conferences, advisory and review committees, the National Science Board, and such groups as the National Research Council. These assessments ensure that breadth and quality are maintained and that NSF and the Nation can draw on the full range of science and engineering in advancing knowledge.

Capitalizing on Emerging Opportunities — To provide sufficient focus within its breadth of activities, NSF conducts assessments like those mentioned above with an eye to emerging areas of science and engineering, challenges in education and human resource development, and other areas presenting particular opportunities or challenges.

Taking Risks — Like all investments, research and education are inherently uncertain ventures. Outcomes are difficult to predict; even in the broader context of whole fields, unexpected results may overturn accepted theory and lead experts to think along completely new paths. NSF must find new ways to encourage its investigators to explore new avenues and pursue activities with high risk and high potential impact. Improved incentives may help overcome concerns investigators may have about how to move in new directions without jeopardizing their resource base and therewith, their productivity.

Reproduced with permission of AT&T

Micro-engineering, where smaller is better, is an important part of NSF's efforts in manufacturing and advanced computing.

Integrating Across Disciplines — Although the disciplinary structure of science and engineering is designed to reflect the underlying order of the natural world, nature in fact knows no disciplinary boundaries. While NSF has a discipline-based organizational structure to facilitate its work, it recognizes the need to ensure that its structure does not create artificial barriers to the support of science and engineering that spans more than one area. NSF will explore and establish organizational mechanisms and programmatic incentives to ensure that multi-disciplinary research and education activities receive appropriate attention.

Establishing Beneficial International Linkages — NSF does not view the pursuit of world leadership as a competition among nations. Research and education in science and engineering benefit immensely from international cooperation. NSF promotes the internationalization of science and engineering in two ways. It enables and encourages U.S. scientists, engineers, and their institutions to avail themselves of opportunities to enhance their research and education programs through international collaboration. NSF also provides future generations of U.S. scientists and engineers with the experience and outlook they will need to function productively in an international research and education environment through support for traveling fellowships and research activities at overseas sites.

These themes form the core of how NSF will enable the U.S. to uphold its position of world leadership in science and engineering. They are nevertheless incomplete, because the Nation's position of world leadership also depends greatly on NSF's efforts toward reaching its other two goals.

Discovery

In the 1930's, physicists set about characterizing the magnetic properties of the nuclei of the elements. If the nucleus had an intrinsic spin, it was found to possess a magnetic moment – that is, to behave as a tiny bar magnet. The goal of this research was to understand the structure of the nucleus. The experiments were done in atomic beams that passed through magnetic fields in which radio waves caused the magnetic moments of the nuclei to change their spatial orientation at certain "resonance" frequencies. These early studies of nuclear magnetic resonance (NMR) provided useful models about how to picture the behavior of the protons and neutrons inside the nucleus, but the complete explication of nuclear structure remains even to this day a major puzzle.

Nevertheless, the major scientific payoff of this research, which certainly was not anticipated by those who carried out these early studies, was not in nuclear physics, but instead in chemistry, where, starting in the late 1950's, NMR has displaced many other forms of chemical analysis. Today, NMR is one of the fundamental tools that chemists employ to analyze molecules in solution and to determine connectivity in compounds – that is, what atoms are nearest neighbors to what others. Countless hours have been saved because chemists can make routine use of NMR to characterize new compounds they synthesize.

But the largest payoff to society may actually be elsewhere—in the realm of medical diagnosis. By using a magnetic field whose strength changes with distance, images can be prepared of the nuclei in a material, such as a whole human body. The technique is called magnetic resonance imaging (MRI). Currently, MRI is increasingly replacing x-rays as the method of choice in visualizing bone and tissue, particularly as a diagnostic tool for recognizing cancerous growths and other tumors.

Who would have thought that wondering about the structure of the nucleus would more than 50 years later be the basis for a new medical procedure (and a new industry) that is saving lives by the early detection of disease states? This example is just one of many such that reveal the surprising interconnections of science and technology. It also illustrates why the National Science Foundation must be willing to invest for the long term in areas of science where the immediate impact on society may not be obvious.

tomorrow's
engineers
BEST COPY AVAILABLE

In Service to Society: NSF Strategic Areas

NSF's second goal, *Promote the discovery, integration, dissemination, and employment of new knowledge in service to society,* highlights why it is in the national interest to uphold a position of world leadership in science and engineering. At the same time, excellence in research and education that serves society is an important component of world leadership.

Among the many research and education frontiers that NSF's programs address are areas of clear strategic importance to the Nation. The Foundation invests a major portion of its resources in these strategic areas, which are organized and focused around specific national objectives identified by the President's National Science and Technology Council (NSTC) and the Foundation's own planning process. It is important to note, however, that the fundamental nature, the quality, and the educational impact of the work supported in these strategic areas does not differ from those of other activities supported by the Foundation.

Within NSF, these research areas emerge from a continuous planning process that takes into account input from many sources, such as reports, workshops, and advisory committees. In this way, NSF both influences and responds to the Administration's National policy for science and technology. NSF's process also considers a number of other factors, such as the availability of infrastructure and resources sufficient to accomplish the objectives, the existence of emerging research opportunities resulting from new capabilities in science and engineering, and the potential to foster partnerships and attract additional resources that can accelerate and increase society's return on the investment. The specific strategic areas and their relative priorities are reviewed annually as part of the planning and budget process. They also are subject to change as the Nation's needs and priorities evolve.

NSF's programmatic activities in the strategic areas are designed in keeping with the Foundation's unique role among Federal agencies and its longstanding partnership with the academic sector. NSF's activities in the strategic areas seek to expand the knowledge base; improve education and training of future scientists, engineers, educators and citizens; stimulate knowledge transfer among academia and the public and private sectors; bring the perspective of many disciplines to bear on complex problems important to the Nation; and enhance components of the infrastructure supporting research and education, including access to the expanded knowledge base.

NSF also aims to foster the natural connections

among the strategic areas, because these interconnections are critical to success. They effectively allow the Foundation to increase the return of its investment in these areas, to reduce duplicative efforts, and to coordinate the allocation of its resources.

NSF Activities in Strategic Areas

The following discussions are based on the coordinating plans developed for NSF's activities in each of the strategic areas. NSF's seven strategic areas are grouped under three related priority areas established by the NSTC — Improved Environmental Quality, Harnessing Information Technology, and Job Creation and Economic Growth.

Improved Environmental Quality

Environmental quality has a broad impact on human health, safety, and quality of life. It affects the quality and quantity of food, fiber, energy and water supplies, as well as the enjoyment of a wide range of recreational opportunities. Environmental issues are diverse, with local, regional and global components. A balanced, comprehensive, integrated and coordinated program of multi-disciplinary research and development is critical to improving environmental quality.

Global Change — Since 1987, NSF has participated in and provided leadership for the U.S. Global Change Research Program (US/GCRP), whose goal is to produce a predictive understanding of the Earth system to support national and international policy-making activities across a broad spectrum of global, national, and regional environmental issues. The primary global change research emphasis at NSF has been the support of activities that advance fundamental understandings of the complex interactions among different facets of the Earth system. In addition to expanding knowledge of physical, biological, and socioeconomic processes, the NSF effort seeks to facilitate data-acquisition and data-management activities necessary for basic research on global change, and it encourages advancement of modeling activities designed to improve representations of Earth system interactions.

Environmental Research — The proper balance of environmental quality and sustainable development poses a major scientific and technological challenge for the twenty-first century. Present and future efforts to preserve, manage and enhance the environment require enhancing current research and education activities. NSF will provide support for interdisciplinary research across a broad front of sciences — biology, chemistry, engineering, geosciences, materials science, mathematics, and the social sciences. This is needed to help address problems whose scope is comparable in size and complexity to that of national defense. Current plans for NSF's Environmental Research effort are built upon four integrating themes: biodiversity, water and watersheds, environmental technology, and resource use and management.

Harnessing Information Technology

Information technology has the potential for improving the quality of life, protecting the environment, safeguarding national security, and ensuring economic growth. Government is working with industry to develop the National Information Infrastructure (NII) that the U.S. will need for the 21st century.

High Performance Computing and Communications — The NSF High Performance Computing and Communications Program (HPCC) supports and elaborates upon a Federal program of the same name. The Federal program seeks to extend US technological leadership in science and engineering, to speed the pace of innovation, and to accelerate wide dissemination and application of high performance computing and communications technologies. This program is organized

into five components: high performance computing systems, advanced software technology and algorithms, national research and education network, basic research and human resources, and information infrastructure technology and applications, the latter most directly linked to the NII.

Job Creation and Economic Growth

Promoting economic growth, creating rewarding jobs, and ensuring U.S. competitiveness in world markets help raise living standards and the quality of life for all Americans. While science and technology are not sufficient to carry out these government objectives, they provide an important component of what is necessary.

Advanced Manufacturing Technology — Manufacturing is a highly integrative activity, and manufacturing-related problems are among the most complex interdisciplinary problems faced by modern society. NSF concentrates on developing the fundamental science and engineering knowledge base that underlies manufacturing technology, management, and education and training, as well as technology transfer, diffusion, and implementation. NSF also focuses on enhancing the institutional, physical and human resources that constitute the manufacturing research and education infrastructure.

Biotechnology — The scientific revolution that has vastly increased our understanding of the living world offers us expanding opportunities to use this knowledge for the welfare of the Earth and humankind. The scientific and engineering research that makes possible these practical applications, broadly termed biotechnology research, can play a critical role in our Nation's future technological strength and economic growth, in preservation and restoration of the environment and biodiversity, and in the health and quality of life of all people. NSF's biotechnology efforts are currently focused on six key research areas that are important to the future economic development and international competitiveness of the United States: environmental biotechnology, bioprocessing, bioelectronics and bionetworks, agricultural biotechnology, marine biotechnology, and the social and economic dimensions of biotechnology.

Advanced Materials and Processing — The 21st century will provide unprecedented opportunity for the exploitation of new materials and new technologies. Powerful new technologies that are no longer materials-limited will provide the Nation with the knowledge and technical capabilities to be fully competitive. Improved materials and processes will play an ever increasing role in efforts to improve energy efficiency, promote environmental protection, ensure security, develop new and improved health-care systems, create an information infrastructure, and provide modern and reliable transportation and civil infrastructure systems. NSF focuses on the synthesis and processing of new and improved materials; theory, modeling and simulation of materials and processing; broad interdisciplinary training; and development and acquisition of advanced instrumentation.

Civil Infrastructure Systems — The vitality of the Nation's civil infrastructure affects its ability to efficiently transport people, goods, energy and information; provide clean air and water; control disease; and conduct commerce. There is an urgent need to rebuild America by emphasizing intelligent renewal of its civil infrastructure systems, a process that is cost-effective and, at the same time, assures high-level performance and longer-term life through continuous technology innovations. Intelligent renewal of infrastructure systems must begin with integrated research that will lead to new designs, more durable materials, new integrated network systems with better controls and communications, and improved decision-making and management processes.

Excellence in Education at All Levels

As part of its mission to promote the progress of science and engineering, NSF supports individuals and groups to undertake activities that ensure a technologically literate populace with the understanding and skills needed for the workforce of the twenty-first century as well as a well-trained cadre of scientists and engineers for the present and the future. Some of these activities take the form of projects dedicated to education and human resource development; others take place in the context of projects aimed at advancing the frontiers of knowledge or addressing strategic national goals.

In forming its investment strategy for education and human resource development, NSF's aim is to ensure that all members of society have real opportunity to succeed in science and technology so that the Nation can draw upon the strength and creativity that the diversity in our society has to offer. In particular, NSF is determined that all students at all levels will be exposed to programs with high standards for understanding and accomplishment; that all students have the opportunity to advance to higher levels; that all students who enter advanced training at the professional level are well and broadly trained; and that the process of learning does not end with the classroom.

Meeting this goal requires efforts from all parts of the Foundation. The undergraduate level plays a pivotal role. It is the conduit through which research can reach the Nation's schools. All NSF organizations have responsibilities at this level. Developing the appropriate blend of broad, flexible underpinnings and focused attention to disciplinary specifics is critical to meeting the full range of NSF objectives.

Four overlapping categories combine with the broad thematic emphases on integrating research and education and building diversity in the human resource base for science and engineering to address the National Science and Technology Council's priority for An Educated Citizenry systematically. They do not cover all aspects of the investment in education and human resources, but they provide a framework for describing the character of the investment.

(1) Systemic Reform K-12 — Since the initial articulation of National Education Goals in 1989, the Federal Government has adopted a comprehensive strategy for working toward the goal centered on making the U.S. first in the world in science and mathematics achievement. Systemic reform is the strategy adopted by NSF (as well as the recently passed GOALS 2000 for the Department of Education) to bring about the changes necessary to make progress towards the goals. Systemic refers to fundamental, comprehensive and coordinated changes made in science, mathematics

and technology education through attendant changes in school policy, financing, governance, management, content and conduct. Specific efforts focus on changes at the state, city, rural areas and local school district levels. Collaboration and development of partnerships are necessary for improvement. Teacher training, curriculum adoption and adaptation, and appropriate assessment are key elements of systemic plans. The outcomes expected are improved science, mathematics and technology education for all students; preparation of a technologically competent and diverse workforce; and enhancement of scientific and technical literacy, understanding, and skills.

(2) Workforce — Developing and maintaining a strong corps of workers for all facets of the American economy are essential to the well-being of the Nation. NSF can play a key role by helping academic institutions to provide a quality science and mathematics education for all students at all levels. Workers well-grounded in science and mathematics are critical to occupations both in and out of the science and technology enterprise. NSF has responsibilities to improve the preparation and enhancement of teachers in the Nation's secondary and elementary schools, to help provide quality science and mathematics experiences for those choosing to enter technician/technologist fields, and to encourage and support young people to pursue careers in science, engineering, and technology at advanced levels. These responsibilities are addressed through curriculum reform, development of faculty and teachers, providing research experiences for students, and promoting learning connected to context, phenomena, and realistic use. Workforce education in science and technology will increasingly become a lifelong process.

(3) Flexibility in Advanced Training for Scientists and Engineers — The development of advanced training for scientists and engineers has occurred largely as a component of research programs, rather than through a strategic consideration of national needs for the science and technology workforce. As a result, many see the current system as one that tends to replicate itself by producing scientists and engineers trained for increasingly narrow - and increasingly limited - research roles. This works against the broader interests of our best students, the increasing diversity of today's generation of students, and the complex and rapidly broadening roles in our society played by those with science and engineering training. NSF aims for a flexibility in advanced training for scientists and engineers that will develop broadly educated people with the knowledge and skills necessary to address the needs of the Nation in a rapidly changing world. Encouraging undergraduate research experiences, developing curricula with broad perspectives and ensuring their dissemination, providing opportunities for students to interface with industry through internships or exchanges, and encouraging a broad view of professional possibilities and responsibilities provide NSF with an approach to developing flexibility. Some of these more broadly educated scientists and engineers will become the faculty members who will help determine the future of the academic enterprise.

(4) Scientific and Technological Literacy — Enhancing the scientific and technological literacy of the American people is seen as one of the keys to global competitiveness and to personal enrichment and quality of life, as well. Citizens who are scientifically and technically literate will be better able to participate in the democratic society by making informed decisions on matters involving science and technology. They will understand the need for a strong and robust science and technology enterprise, support its inclusion as a Federal funding priority, and encourage and motivate young people to study science and mathematics. Stronger efforts to disseminate the results of research are necessary to gain the understanding and support of citizens and legislators. Creative uses of museums, zoos, radio and television, libraries, and other non-academic organizations will be increasingly important in meeting this responsibility.

NSF's Guiding Principles

The National Science Foundation is in many ways a unique Federal agency. Its relationships with the academic research community and with the science and engineering education community must be both a working, trusting partnership and an arm's length, impartial interaction. In managing the Federal research investment, NSF must simultaneously be part of the research and education community and independent of it. The following set of guiding principles allows the Foundation to maintain this delicate balance.

STEWARDSHIP: As responsible trustees of public funds, NSF will provide the American people with the best possible management of its investment in research and education in science and engineering:

- We work with many others who share our values and goals: colleges, universities, private industry, other governmental agencies, and scientists and engineers in other countries.
- We are committed to putting research and education in science and engineering to work for the American people, and to helping the public understand the importance of research and education for their lives.
- We rely on our proven system of merit review, which weighs each proposal's technical merit, creativity, educational impact, and its potential benefits to society.
- We promote professional integrity in our own work and in the research and education we support.
- We strive to bring research and education closer together at every level, from hands-on inquiry-based teaching in grade school to dissertation research in graduate school, and beyond.

LEADERSHIP: The researchers and educators supported by NSF are eager to pursue new opportunities for knowledge and educational reform wherever they occur. As the leading Federal supporter of fundamental research and education in science and engineering, it is essential to identify areas of national need as well as areas of intellectual opportunity:

- We accept the challenge of leadership and the responsibilities that go with it.
- We identify and promote research with the greatest potential, whether or not it fits traditional views.
- We promote education in all segments of society, whether or not they have been part of the scientific and engineering traditions.

IMPACT: NSF and the community it serves are convinced that science and engineering can improve our world, our society, and ourselves:

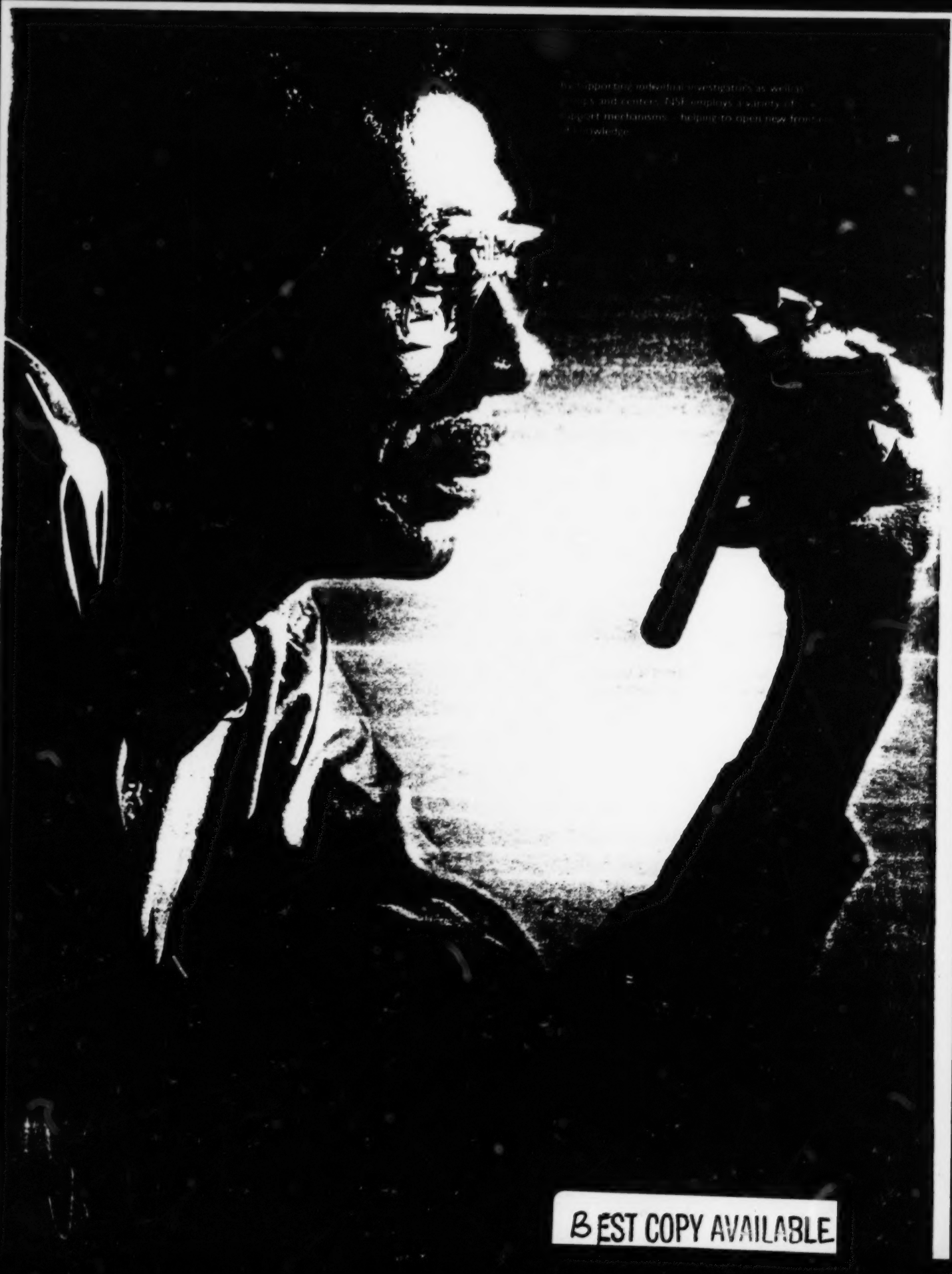
- We have seen that research and education in science and engineering can address fundamental needs around the world.
- We see the extraordinary benefits that scientific and technological breakthroughs have bestowed on our society.
- We are renewed by the never-ending challenges of research and discovery.
- We strive to affect the structure of institutions in positive ways.

EXCELLENCE: NSF and the community it serves are committed to Excellence, as a personal and an organizational standard:

- We strive to develop the potential for excellence in ourselves and others.
- We find excellence and the potential for excellence in all parts of our population, and we work hard to identify and nurture excellence wherever it may occur.
- We believe that excellence is contagious: creating pockets of excellence will lead to widespread impact.
- We place a high value on creativity; it is the fuel that drives excellence.

OPENNESS: NSF and the community it serves are committed to the sharing of information and a free marketplace of ideas:

- We conduct our business in an open manner, inviting advice from and evaluation by our customers.
- We disseminate information on our programs in every way possible, to promote fair and equal access to funding opportunities.
- We are vigorous supporters of computer networks that accelerate and widen the flow of information and ideas.
- We assure the open dissemination of the results of NSF-supported research; we do not support classified research.



BEST COPY AVAILABLE

Approaches to Implementation

To meet the challenges of the changing world, NSF will use a variety of approaches in pursuing its goals. NSF's future will see support of teams, centers, and consortia as well as individual investigators; focused proposal solicitations as well as unsolicited proposals; increased emphasis on integration of knowledge; and increasing reliance on partnerships. This section outlines a few of these approaches.

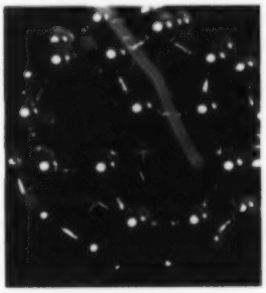
Offer Different Modes of Support — The needs and opportunities of the science and engineering enterprise come in all shapes and sizes. The challenge to NSF is to meet these needs and pursue these opportunities in ways that are appropriate in each case. Many NSF projects are well suited to the traditional mode of supporting an individual investigator. Some research questions and education initiatives require support for groups of specialists. Other problems will yield only to high levels of sustained support provided to research or education Centers. High risk projects sometimes need small grants for short-term exploration, while other projects require sustained periods of support in order to study long-term processes. Research sometimes requires specialized instruments or facilities, and many areas of science and engineering require dedicated research platforms that are beyond the size and scale available to individuals or small groups. NSF must provide a variety of instruments and facilities necessary for the conduct of pioneering research and education.

Improve Agency Efficiency and Accountability — As the steward for public investments in science and engineering research and education, NSF is committed to improving its organizational performance. Developing credible performance measures and assessment methods is a critical component of NSF planning. NSF's data collection program will enable policy makers and the general public to monitor the progress that NSF is making toward its goals. This will require continuous improvement of proposal review, grant making and other processes, including response time. Merit review with peer evaluation is the core of NSF's decision making process. NSF is committed to making this an open, fair, and robust process. Accountability for public funds will demand assessment of the effectiveness of agency operations and the return on the

An important approach to carrying out NSF's mission is to help the Nation use new knowledge in science and engineering for the benefit of society.

Foundation's investment strategies.

Promote Intellectual Integration — Intellectual integration brings the knowledge and skills from different disciplines to bear on complex problems. NSF will encourage intellectual integration among fields of science and between research and education missions. Collaboration across traditional disciplinary boundaries is a positively reinforcing process: the first interdisciplinary discoveries lead to the discovery of many new problems at that disciplinary interface. Innovative research methods and tools can stimulate the imagination of researchers at disciplinary frontiers and open new paths for action. Integration of research and education activities maintains the currency of what is taught, ensuring an up-to-date research community and a technically agile workforce.



The strong, flexible buckyball molecule has potential applications in materials sciences and micro-engineering.

Accelerate Knowledge Transfer — An important approach to carrying out NSF's mission is to help the Nation use new knowledge in science and engineering for the benefit of society. The transfer of such knowledge is a vital ingredient in enhancing the Nation's industrial competitiveness. NSF's knowledge transfer activities are focused on building working relationships at the research project level between academia, industry, and other potential users, such as local and State governments. Knowledge is used most rapidly when those charged with discovery are in close contact with those charged with applying new knowledge. This approach is particularly effective when there are one-to-one working relationships and people exchanges; for example, when university-trained researchers and professionals move to industry and vice-versa.

NSF, while increasing its support for fundamental research, also has assumed a greater concern with technology and the transfer of knowledge to industry.

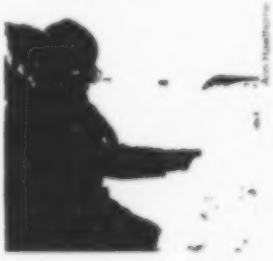
Reflecting changing national priorities, there has been a gradual shift so that NSF, while increasing its support for fundamental research, has also assumed a greater concern with technology and the transfer of knowledge to industry. NSF has established programs that are actively oriented toward knowledge transfer: for example, multidisciplinary centers with technology transfer as explicit components of their research mission, Small Business Innovation Research (SBIR), and Small Business Technology Transfer (STTR) programs, which help to move the results of basic exploratory research to the marketplace.

BEST COPY AVAILABLE

BEST COPY AVAILABLE

Planning and Allocation of Resources

The goals, strategies, and approaches outlined in the previous sections provide the strategic framework within which the Foundation and its organizational units will prepare performance plans, allocate resources, and assess results. NSF's three interrelated goals and the various strategies and approaches needed to achieve them ultimately require a balanced approach.



Polar research uncovers history locked in snow.

The successful implementation of this framework is the next (and perhaps most challenging) step in this strategic planning process. Just as any investor seeks a balanced and diversified portfolio, the Foundation strives for balance among the elements of its varied portfolio in order to maximize its overall value to the public. There is no simple formula to do this, for the ideal balance changes continually. If successfully implemented, this plan and the Foundation's planning process will provide the guidance necessary to attain a timely balance.

Criteria for Implementation

An implementation plan to complement this strategic plan is now under development. This plan will establish criteria — such as consistency with NSF and NSTC goals, appropriateness for NSF (in the interagency context), timeliness of proposed activities and readiness of the community to carry them out with requisite quality, and the potential for partnerships — to set priorities for NSF activities.

Acknowledgments

National Science Foundation

Dr. Neal F. Lane, Director

Dr. Anne C. Petersen, Deputy Director

Director's Policy Group (DPG)

The Director's Policy Group, the senior management of the Foundation, consists of the Foundation's Assistant Directors and Office Heads.

Dr. Joseph Bordogna, Assistant Director, Engineering (ENG)

Dr. Marta Cehelsky, Executive Officer, National Science Board (NSB)

Dr. Mary E. Clutter, Assistant Director, Biological Sciences (BIO)

Mr. Thomas N. Cooley, Staff Associate, Office of the Director (O/D)

Dr. Robert W. Corell, Assistant Director, Geosciences (GEO)

Dr. Karl A. Erb, Senior Science Advisor, Office of the Director (O/D)

Dr. William C. Harris, Assistant Director, Mathematical and Physical Sciences (MPS)

Mr. Joseph L. Kull, Director, Office of Budget, Finance and Award Management (BFA)

Dr. Cora B. Marrett, Assistant Director, Social, Behavioral and Economic Sciences (SBE)

Ms. Constance K. McLindon, Director, Office of Information and Resource Management (IRM)

Dr. Nathaniel G. Pitts, Director, Office of Science & Technology Infrastructure (OSTI)

Mr. Lawrence Rudolph, Acting General Counsel, Office of the General Counsel (OGC)

Dr. Cornelius W. Sullivan, Director, Office of Polar Programs (O/D)

Ms. Linda G. Sundro, Inspector General, Office of the Inspector General (OIG)

Dr. Judith S. Sunley, Assistant to the Director for Science Policy and Planning (O/D)

Mr. Joel M. Widder, Acting Director, Office of Legislative and Public Affairs (OLPA)

Dr. Luther S. Williams, Assistant Director, Education and Human Resources (EHR)

Dr. Paul R. Young, Assistant Director, Computer and Information Science and Engineering (CISE)

National Science Board

Dr. Frank H. T. Rhodes, Chairman, National Science Board, President, Cornell University, Ithaca, NY

Dr. Marye Anne Fox, Vice Chairman, National Science Board, The University of Texas at Austin, Austin, TX

The National Science Board is the policy making body of the National Science Foundation, with the added responsibilities to recommend and encourage the pursuit of national policies for the promotion of research and education in the sciences and engineering.

Dr. Perry L. Adkisson, Texas A&M University, College Station, TX

Dr. Bernard F. Burke, Massachusetts Institute of Technology, Cambridge, MA

Dr. F. Albert Cotton, Texas A&M University, College Station, TX

Dr. Thomas B. Day, President, San Diego State University, San Diego, CA

Dr. James J. Duderstadt, President, The University of Michigan, Ann Arbor, MI

*Dr. Sanford D. Greenberg, Chairman & CEO, TEI Industries, Inc., Washington, DC

Dr. Phillip A. Griffiths, Director, Institute for Advanced Study, Princeton, NJ

Dr. Charles E. Hess, University of California, Davis, CA

Dr. John E. Hopcroft, Cornell University, Ithaca, NY

Dr. Shirley M. Malcom, American Association for the Advancement of Science, Washington, DC

*Dr. Eve L. Menger, Corning, Inc., Corning, NY

*Dr. Claudia I. Mitchell-Kernan, University of California, Los Angeles, CA

*Dr. Diana Natalicio, President, The University of Texas at El Paso, El Paso, TX

Mr. Jaime Oaxaca, Coronado Communications Corporation, Los Angeles, CA

Dr. James L. Powell, Director, Los Angeles County Museum of Natural History, Los Angeles, CA

Dr. Ian M. Ross, President-Emeritus, AT&T Bell Laboratories, Holmdel, NJ

Dr. Howard E. Simmons, Jr., DuPont Experimental Station, Wilmington, DE

*Dr. Robert M. Solow, Massachusetts Institute of Technology, Cambridge, MA

*Dr. Warren M. Washington, National Center for Atmospheric Research, Boulder, CO

*Dr. John A. White, Jr., Georgia Institute of Technology, Atlanta, GA

Dr. Richard N. Zare, Department of Chemistry, Stanford University, Stanford, CA

Member *ex officio*

Dr. Neal F. Lane, Director, National Science Foundation, Arlington, VA

BEST COPY AVAILABLE

*NSB nominee pending U.S. Senate confirmation

You can get information fast through STIS (Science and Technology Information System), NSF's online publishing system, described in the "STIS Flyer" (NSF 94-2).

To get a paper copy of the flyer, order by FAX (703-644-4278) or electronically via E-mail. Send E-mail requests to pubs@nsf.gov. (Internet) or order via voice-mail at (703-306-1130).

The National Science Foundation has TDD (Telephonic Device for the Deaf) capability, which enables individuals with hearing impairment to communicate with the Foundation about NSF programs, employment, or general information. This number is (703) 306-0090.